

## **Lab 12 Report**

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IST 894-001: Capstone Experience

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## General Overview

This lab introduces participants to several new methods of vulnerability analysis and security event monitoring.

The lab begins with an introduction to static code analysis — the practice of examining source code for bugs and other issues. In this case, participants are specifically focusing on using static code analysis to find vulnerabilities. Using MobSF, a tool for assessing the security of mobile applications (Kusreynada & Barkah, 2024), users perform static code analysis on an Android application designed specifically for the lab. After MobSF completes its analysis, users are able to view a report detailing the security risks found in the application's source code.

The lab then switches focus to the topic of web application vulnerabilities. By the time they participate in this lab, participants will have already a good deal of familiarity with this topic; however, this lab approaches it from an angle slightly different from what they are used to. Instead of exploiting a deliberately insecure app and observing the consequences of common vulnerabilities, they instead see an example of an app that successfully defends against one particular common vulnerability — arbitrary code execution.

Participants make several attempts to perform arbitrary code execution in the app, only to discover that the app appropriately sanitizes user input, rendering their attacks futile.

Participants are able to see firsthand the benefits of proper input validation and secure coding practices (Wang et al., 2024).

The remainder of the lab focuses on incident detection and analysis. Participants investigate simulated security incidents using Splunk, a popular tool for searching and analyzing logs, to examine system logs for suspicious behavior. Participants also learn to detect phishing attacks in an exercise where they examine the headers and metadata of several emails to determine whether or not they originated from the source they claim to originate from. These exercises reinforce what participants should, by this point, already be familiar with: the importance of centralized monitoring in responding to attempted cyberattacks (Eze & Shamir, 2024; Messina et al., 2015).

# Technical Overview

This lab introduces participants to several new methods of vulnerability analysis and security event monitoring.

The lab begins by introducing participants to static code analysis. Participants perform static code analysis on a deliberately-vulnerable APK using a containerized deployment of MobSF. After installing Docker and getting the MobSF container running, they upload the APK to MobSF and examine a report detailed the APKs permissions, exported services and activities, and behaviors it exhibits that have the potential to be dangerous.

The lab then turns its focus to web application vulnerabilities. Participants attempt to perform arbitrary code execution on a web application — something they have done before in prior labs. This time, however, the application has been programmed to properly sanitize user input, and no ACE vulnerability is actually present. Participants make several attempts to obtain user information through ACE — using commands like *id* and *whoami* — to no avail. They then find out exactly why their attacks failed by examining the application's PHP source, from which they learn that a basic string replacement algorithm is used for input sanitization.

The remainder of the lab focuses on incident detection and analysis. Participants use a locally hosted Splunk instance to examine an Apache access log. They are given a surface

level introduction to Splunk's proprietary Search Processing Language and use SPL commands to analyze the access log and identify suspicious behavior. Participants also learn to identify assess the legitimacy of emails and identify potential phishing attacks by examining email headers and metadata.

## References

- Eze, C. S., & Shamir, L. (2024). *Analysis and prevention of AI-based phishing email attacks* (No. arXiv:2405.05435). arXiv. <https://doi.org/10.48550/arXiv.2405.05435>
- Kusreynada, S. U., & Barkah, A. S. (2024). Android apps vulnerability detection with static and dynamic analysis approach using MOBSF. *Journal of Computer Science and Engineering (JCSE)*, 5(1), 46–63. <https://doi.org/10.36596/jcse.v5i1.789>
- Messina, A., Fontana, I., & Giacalone, G. (2015). *Log monitoring and analysis with rsyslog and Splunk*. Unpublished. <https://doi.org/10.13140/RG.2.1.2153.5128>
- Wang, X., Zhai, J., & Yang, H. (2024). Detecting command injection attacks in web applications based on novel deep learning methods. *Scientific Reports*, 14(1), 25487. <https://doi.org/10.1038/s41598-024-74350-3>

# Screenshots

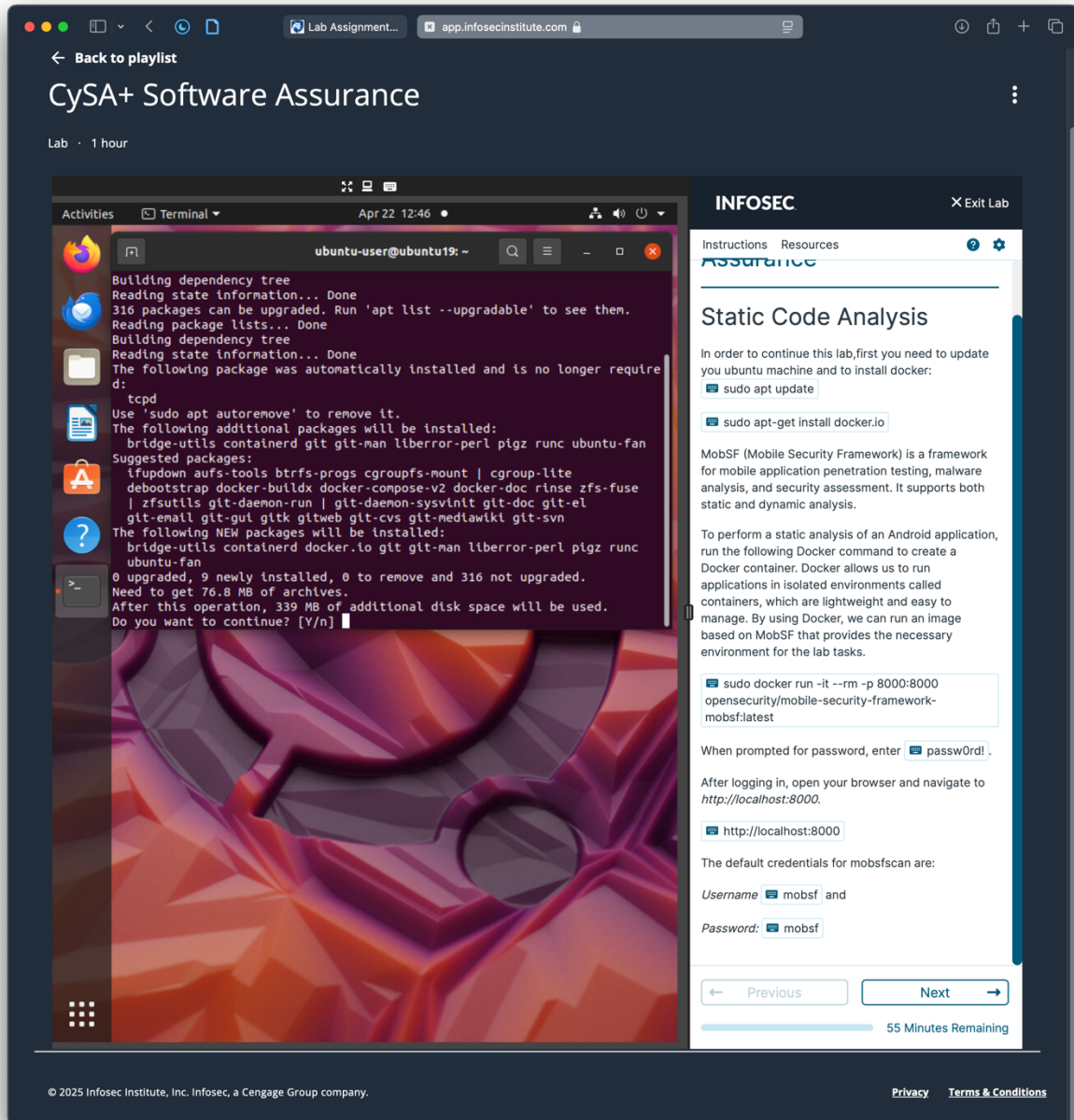


Figure 1. Installing Docker.



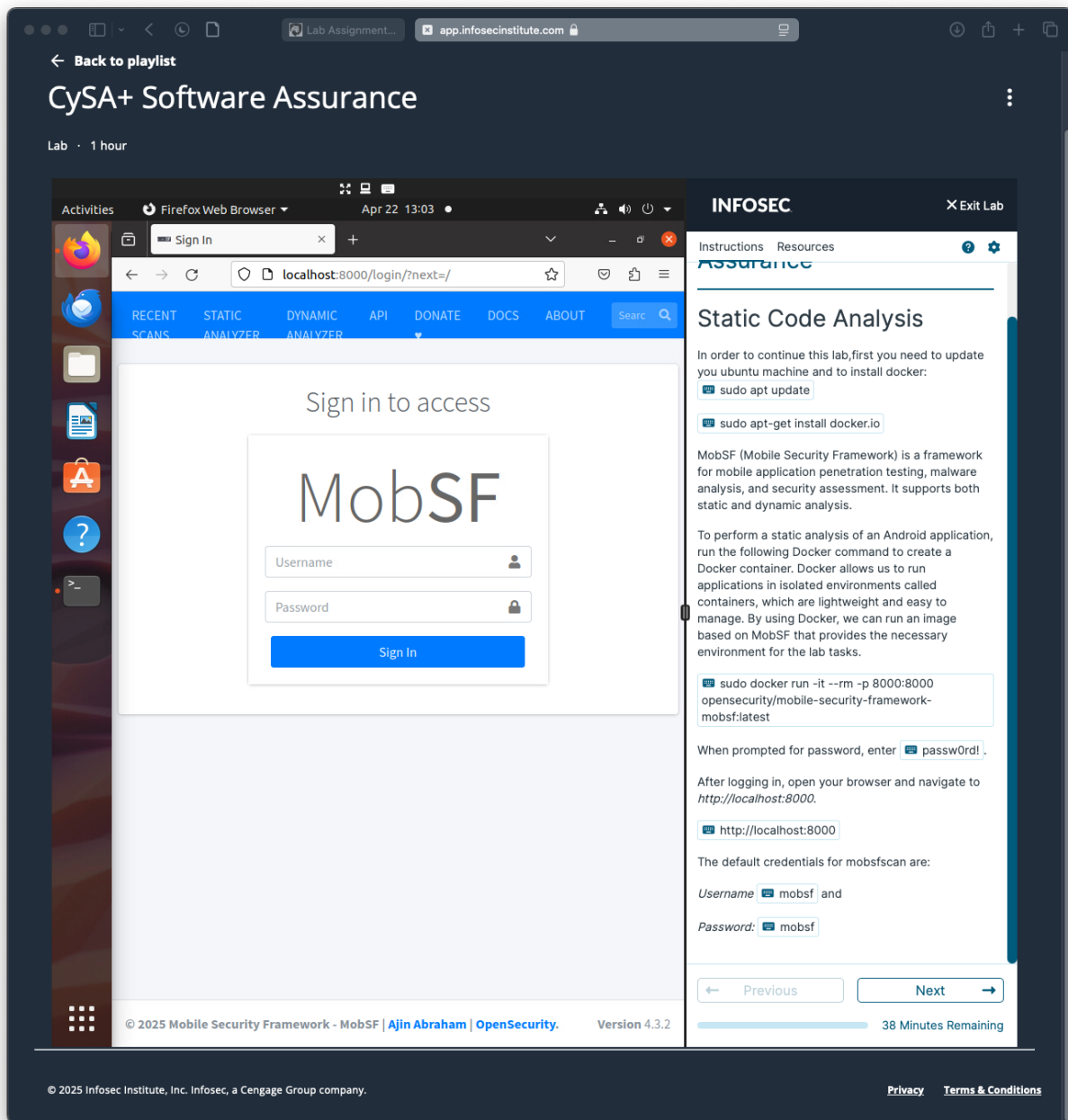


Figure 2. The MobSF login screen.



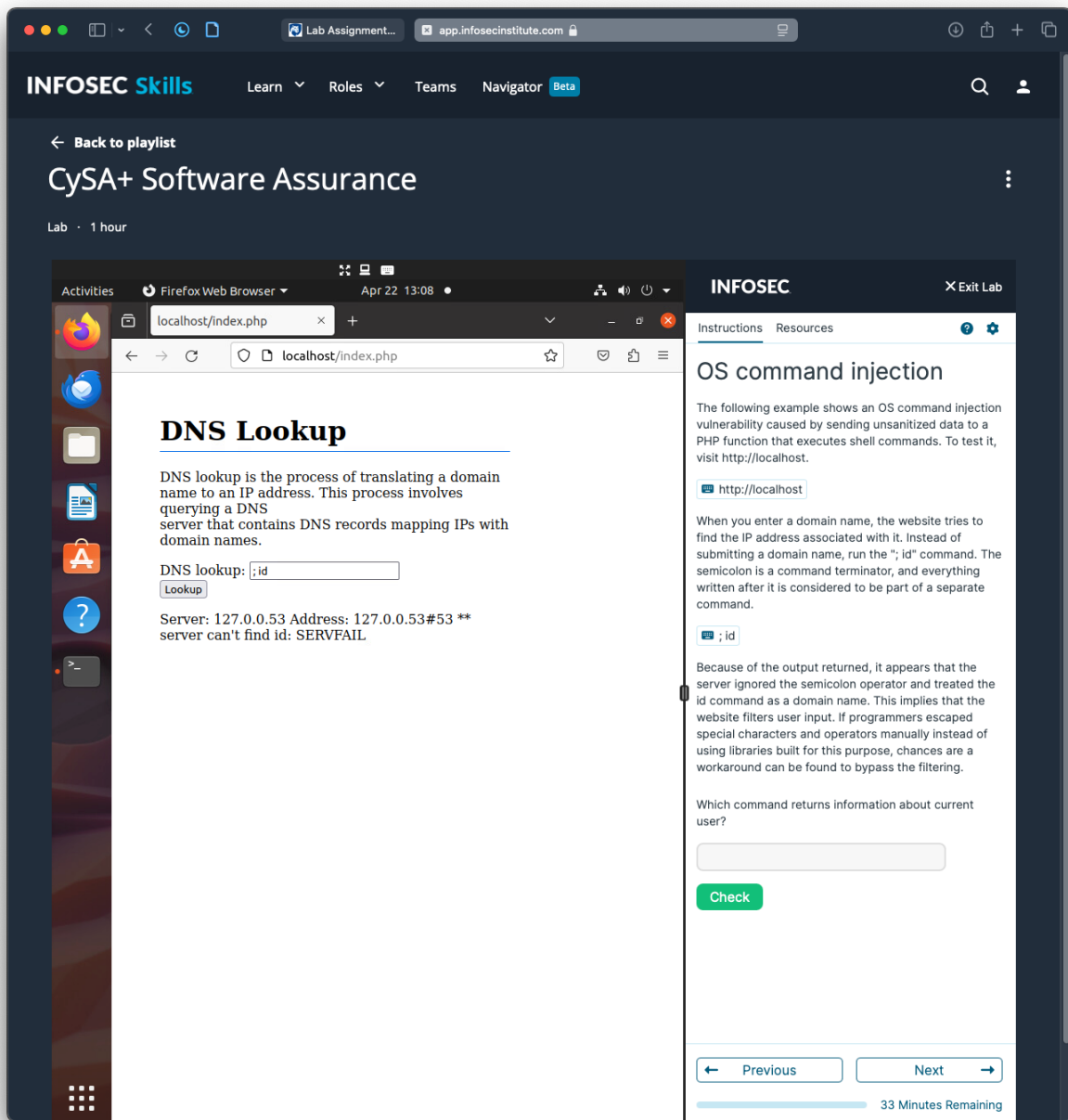


Figure 4. Demonstrating that the web application running on port 80 of the virtual machine sanitizes user input.

The screenshot displays the INFOSEC Skills web application interface. The main header includes the logo "INFOSEC Skills" and navigation links: "Learn", "Roles", "Teams", and "Navigator" (marked as Beta). A search icon and a user profile icon are also present. Below the header, a "Back to playlist" link is visible, followed by the lab title "CySA+ Software Assurance" and a duration of "Lab · 1 hour".

The central part of the interface is a terminal window titled "Activities" and "Terminal". It shows a command prompt for "ubuntu-user@ubuntu19: ~" with the command `sudo nano /var/www/html/index.php` executed. The terminal displays the source code of a web application, which includes HTML, CSS, and PHP. The code defines a form for a "DNS lookup" and includes a PHP script that echoes the script name. The code is as follows:

```
DOCTYPE html>
<html lang="en" dir="ltr">
<head>
  <meta charset="utf-8">
  <title></title>
  <link rel="stylesheet" href="style.css">
</head>
<body>
  <div style="margin: 50px 200px 0 50px">
    <div class="col-2"></div>
    <div class="col-8">
      <h1 style="border-bottom: 1px solid #006AE8;padding-bottom:5px">
        <p> DNS lookup is the process of translating a domain name to
        <form action="<?php echo($_SERVER["SCRIPT_NAME"]); ?>" method="
        <p>
          <label for="target">DNS lookup:</label>
          <input type="text" id="target" name="target" value="
          <br>
          <button class="button-22" type="submit" name="form">
            Read 38 lines
      </div>
    </div>
  </div>
</body>
</html>
```

The terminal window also shows a list of keyboard shortcuts at the bottom: "Get Help", "Write Out", "Where Is", "Cut Text", "Justify", "Exit", "Read File", "Replace", "Paste Text", and "To Spell".

On the right side of the interface, there is a sidebar titled "INFOSEC" with an "Exit Lab" button. It contains a section titled "Assessing the application's security" with instructions: "To view the code causing this issue, use nano to open the /var/www/html/index.php file:". Below this, there is a code block showing the command `sudo nano /var/www/html/index.php`. The sidebar also includes a "Check" button and a "Congratulations, you have reached the end of this lab!" message. At the bottom of the sidebar, there is a "Mark Complete" checkbox and a "30 Minutes Remaining" timer.

Figure 5. Examining the source code of the web application running on port 80 of the virtual machine.

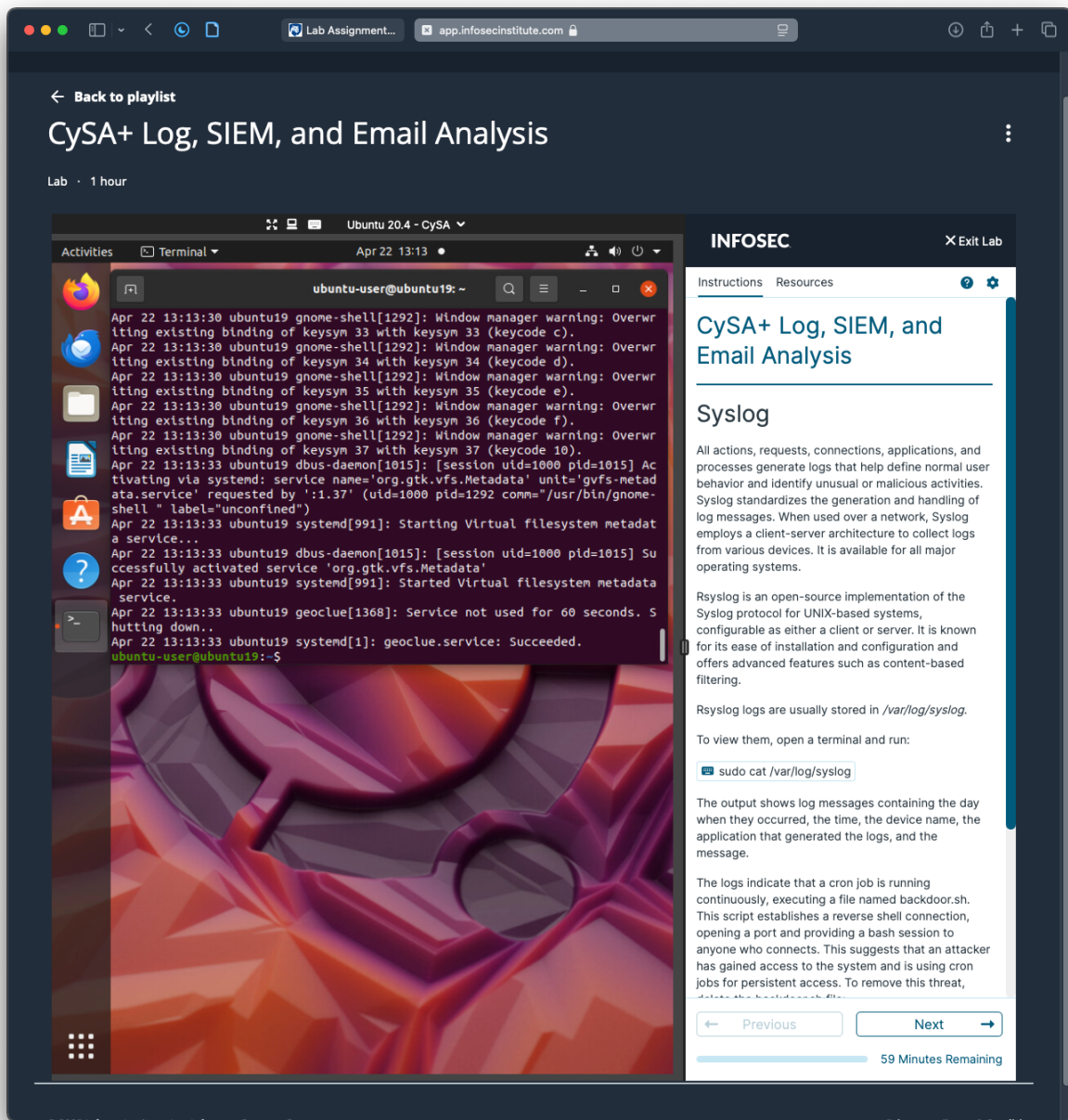


Figure 6. Viewing /var/log/syslog.

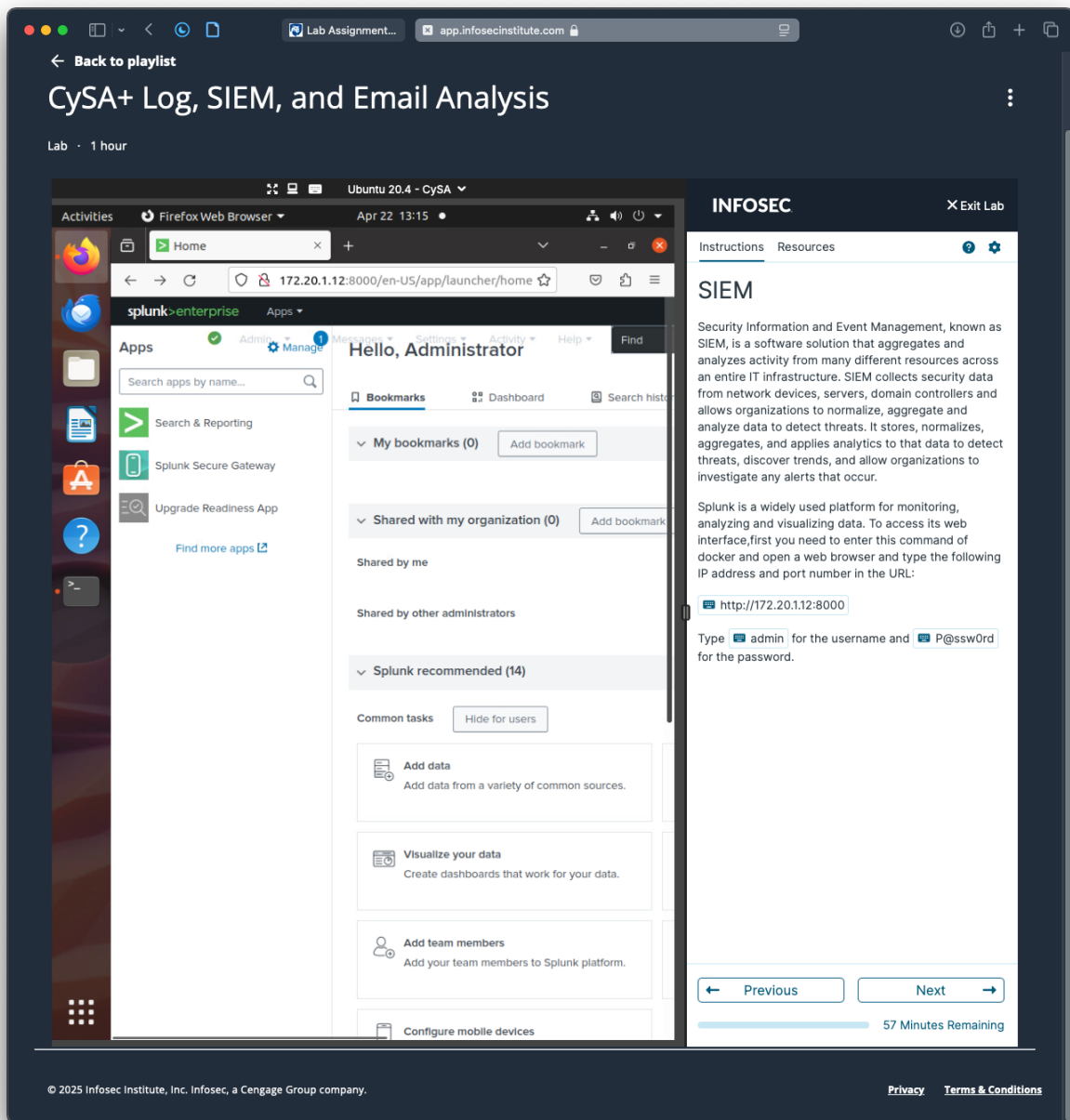


Figure 7. The Splunk user interface.





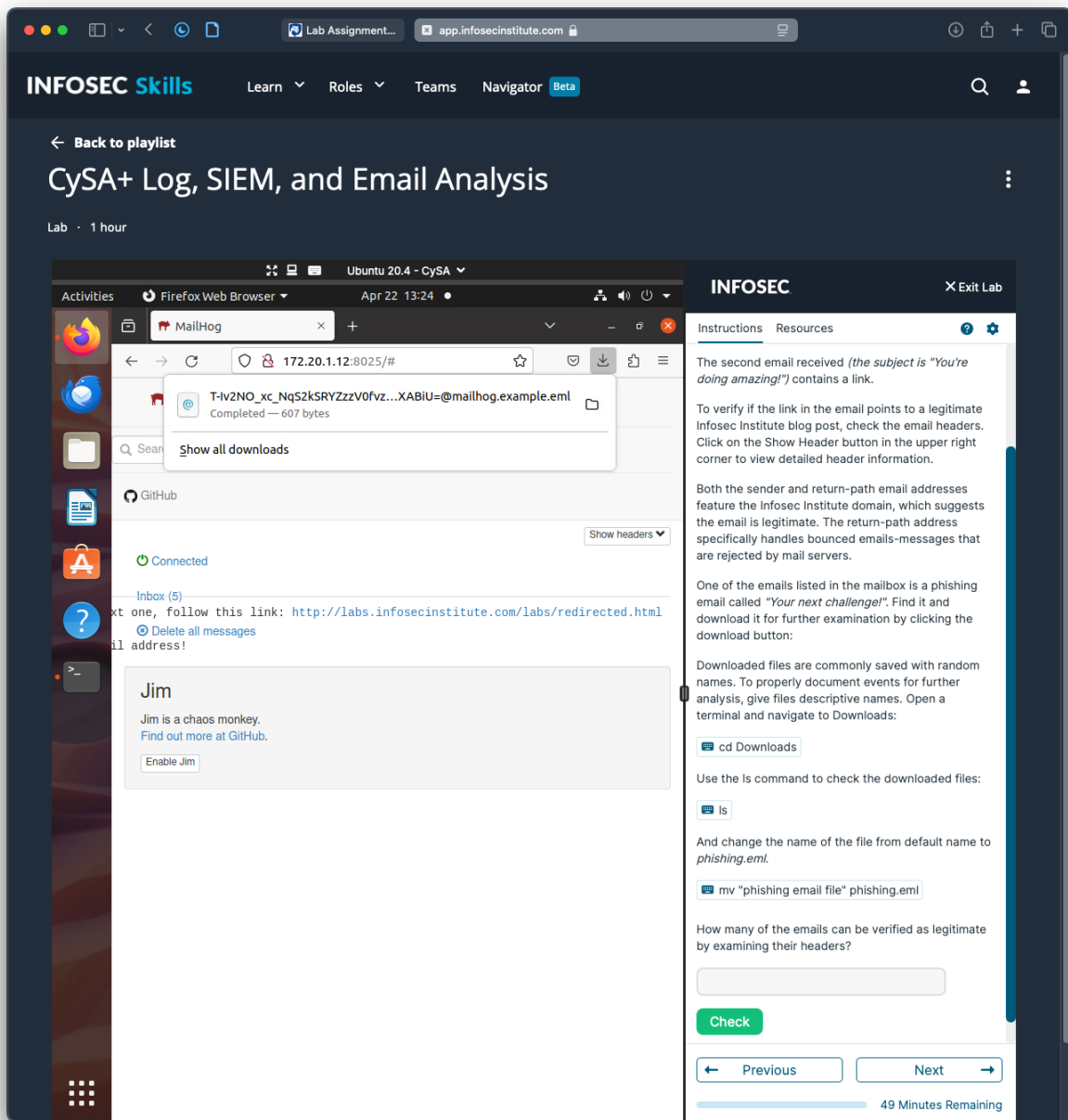


Figure 9. Downloading the email with the subject line "Your next challenge!".



The screenshot displays the INFOSEC Skills web application interface. The main header includes the logo, navigation links (Learn, Roles, Teams, Navigator), and a search icon. The lab title is "CySA+ Log, SIEM, and Email Analysis" with a duration of 1 hour. The lab environment is Ubuntu 20.4 - CySA.

The terminal window shows the following commands and output:

```
ubuntu-user@ubuntu19: ~/Downloads
ubuntu-user@ubuntu19:~$ cd Downloads
ubuntu-user@ubuntu19:~/Downloads$ ls
'T-Iv2NO_xc_Nq52kSRyZzzV0fvzNJDsyYt583DXABtU@mailhog.example.eml'
ubuntu-user@ubuntu19:~/Downloads$ mv *.eml phishing.eml
ubuntu-user@ubuntu19:~/Downloads$ ls
phishing.eml
ubuntu-user@ubuntu19:~/Downloads$
```

The right sidebar contains instructions and resources. The instructions section includes the following text:

doing amazing!") contains a link.

To verify if the link in the email points to a legitimate Infosec Institute blog post, check the email headers. Click on the Show Header button in the upper right corner to view detailed header information.

Both the sender and return-path email addresses feature the Infosec Institute domain, which suggests the email is legitimate. The return-path address specifically handles bounced emails-messages that are rejected by mail servers.

One of the emails listed in the mailbox is a phishing email called "Your next challenge!". Find it and download it for further examination by clicking the download button:

Downloaded files are commonly saved with random names. To properly document events for further analysis, give files descriptive names. Open a terminal and navigate to Downloads:

`cd Downloads`

Use the `ls` command to check the downloaded files:

`ls`

And change the name of the file from default name to `phishing.eml`.

`mv "phishing email file" phishing.eml`

How many of the emails can be verified as legitimate by examining their headers?

48 Minutes Remaining

Figure 10. Renaming the downloaded email (see Figure 9) to "phishing.eml".